MINERAL CHEMISTRY OF ORE MINERALS IN THE SAN JOSE MINE OF THE ORURO DISTRICT, BOLIVIA

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INTRODUCTION

The San José deposit is one of the most important in the Oruro District. It is located in the Oruro town (Bolivia) and it is operated by artisanal mining. San José belongs to the Central Andean tin belt and is related to an intrusive porphyry body, concurrent with the San Pablo stock, of the Morococala formation; which is hosted in a meta-sedimentary sequence of Silurian age.

The present work is focused in mineral characterization, paragenesis and in content from the minerals of the San José deposit.

GEOLOGICAL SETTING

The San José deposit is one of the most important in the Oruro District. It is located in the Oruro town (Bolivia) and belong to the Central Andean tin belt. The San José deposit is related to an intrusive porphyry body, concurrent with the San Pablo stock, of the Morococala formation; which is hosted in a meta-sedimentary sequence of Silurian age.

METHODOLOGY

Minerals were observed by scanning electron microscopy (SEM). Electron microprobe analyses were carried out in order to determine the mineral chemistry of the minerals.

RESULTS and discussion

Mineralogy

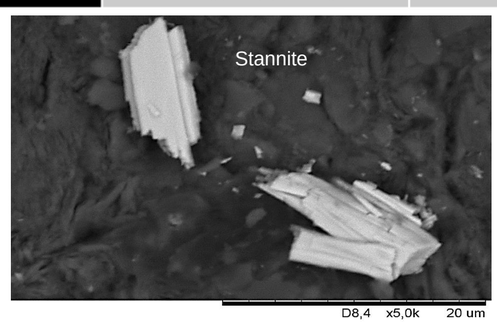
Ore mineralization occurs as veins and hydrothermal breccias around the San José and Itos stocks. Veins are filled with quartz and an ore mineral assemblage of cassiterite, galena, pyrite, sulfosalts, Ag and In-bearing sulfides.

Preliminary microprobe analyses indicate that In values of 3 wt. % are common, especially in members of stannite group. Sphalerite has up to 12.4 wt.% Fe and 1.94 wt.% of Cd and 0.8 wt.% In. In contents inversely correlates with the Fe contents. In cassiterite In occassionaly reach up to 0.99 wt.%, but the most common contents are 0.10-0.20 wt.%.

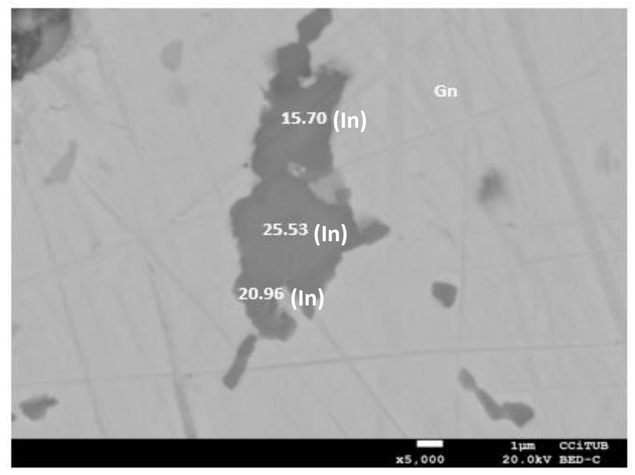
Stannite occurs in significant amounts; crystals are small, up to 25 µm, and in most cases are found filling cavities or following cleavage in hosted minerals as galena, sphalerite and pyrite. Likewise, sulfosalts as boulangerite, jamesonite, pyrargyrite, andorite, cylindrite, argentite, berndtite, ramhdorite, terrywallacite and greenockite are abundant in porosity and fractures.

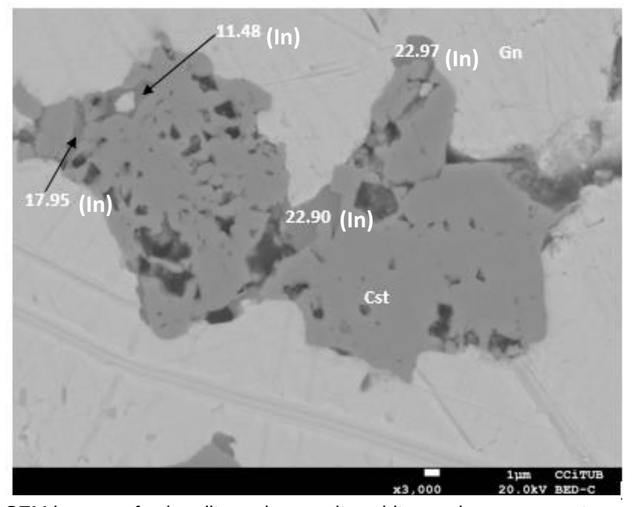
Alteration is abundant, mainly kaolinitization. In this stage disseminations of small crystals, which include monazite and alunite group minerals.

Fase mineral	Formula estructural	Serie mineral
Óxidos		
Casiterita*	SnO_2	Rutilo
Sulfuros simples		
Galena*	$Pb_{0.971}S_{0.999}$	Galena
Pirita*	$Fe_{0.990}S_2$	Pirita
Calcopirita*	$Cu_{1.050}Fe_{0.442}S_{1.999}$	Calcopirita
Arsenopirita*	$As_{0.980}Fe_{0.882}S$	Arsenopirita
Marcasita	FeS_2	Marcasita
Estibina	Sb_2S_3	Estibina
Esfalerita*	$Zn_{0.972}Fe_{0.068}S_{0.999}$	Esfalerita
Fosfatos		
Monacita	$T.R.(PO_4)$	Monacita
Plumbogumita	$PbAl_3(PO_4)(PO_3OH)(OH)_6$	Plumbogumita
Sulfatos		
Alunita	$KAl_3(SO_4)_2(OH)_6$	Alunita



Serie mineral	Fase mineral	Formula
Kësterita-Estannita	Estannita	$Cu_{2.073}Fe_{1.004}Sn_{1.009}S_{3.993}$
Kësterita-Estannita	Estannita	$Cu_{2.086}Fe_{0.633}Sn_{1.037}S_{3.996}$
Kësterita-Estannita	Estannita	$Cu_{2.028}Fe_{0.633}Sn_{0.969}S_{3.999}$
Kësterita-Estannita	Estannita	$Cu_{1.711}Fe_{0.897}Sn_{0.819}S_{3.998}$
Sartorita	Twinnita	$Pb_{5.644}Sb_{4.209}S_{11}$
Sartorita	Twinnita	$Pb_{5.667}Sb_{4.310}S_{10.999}$
Sartorita	Twinnita	$Pb_{5.753}Sb_{4.294}S_{10.995}$
Sartorita	Twinnita	$Pb_{5.744}Sb_{4.180}S_{10.985}$
Boulangerita	Boulangerita	$Pb_{0.994}Sb_{2.306}As_{0.010}S_{3.980}$
Boulangerita	Boulangerita	$Pb_{0.958}Sb_{2.082}As_{0.013}S_{3.991}$
Boulangerita	Boulangerita	$Pb_{1.049}Sb_{2.321}As_{0.003}S_{3.988}$
Boulangerita	Boulangerita	$Pb_{1.021}Sb_{2.150}As_{0.006}S_{3.987}$
Cilindrita	Cilindrita	$FePb_{7.956}Sn_{2.531}Sb_{2.330}S_{15.991}$
Cilindrita	Franckeita	$Pb_{6.743}Sn_{2.210}Fe_{0.922}Sb_{2.098}S_{14}$
Cilindrita	Franckeita	$Pb_{6.767}Sn_{2.157}Fe_{0.878}Sb_{2.077}S_{14}$
Cilindrita	Franckeita	$Pb_{6.776}Sn_{2.358}Fe_{0.930}Sb_{2.157}S_{13.992}$
Gustavita-Lyllianita	Terrywallaceita	$Ag_{0.920}Pb_{0.703}Sb_{2.340}Bi_{0.587}S_{5.934}$
Gustavita-Lyllianita	Andorita	$Cu_{1.711}Fe_{0.897}Sn_{0.819}S_{3.998}$
Tetrahedrita-Tennantita	Freibergita	$Ag_{2.336}Cu_{7.738}Fe_{1.485}Sb_{4.074}As_{0.049}S_{12.500}$
Tetrahedrita-Tennantita	Freibergita	$Ag_{2.372}Cu_{7.619}Fe_{1.476}Sb_{3.935}As_{0.042}S_{12.500}$
Tetrahedrita-Tennantita	Freibergita	$Ag_{2.265}Cu_{7.865}Fe_{1.145}Sb_{4.219}As_{0.013}S_{12.491}$
Tetrahedrita-Tennantita	Tetrahedrita	$Cu_{8.158}Sb_{4.257}S_{12.986}$
Kësterita-Estannita	Petrukita / Sakuraiita	$Cu_{1.953}Zn_{0.195}Fe_{0.025}In_{2.060}Sn_{1.556}S_{3.996}$
Kësterita-Estannita	Petrukita / Sakuraiita	$Cu_{1.854}Zn_{0.165}Fe_{0.030}In_{2.493}Sn_{0.382}S_{3.996}$

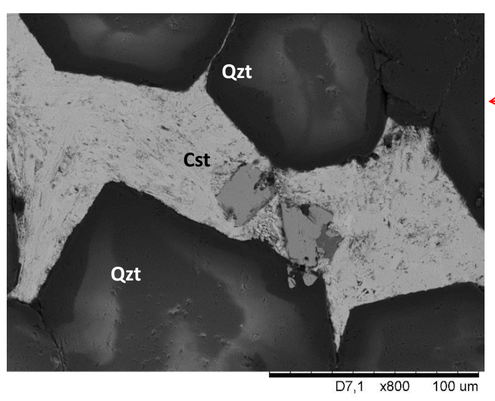


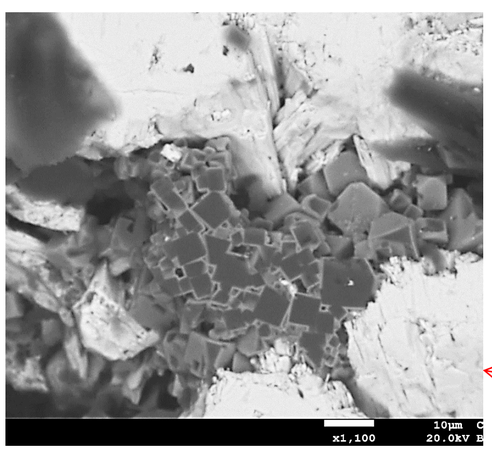


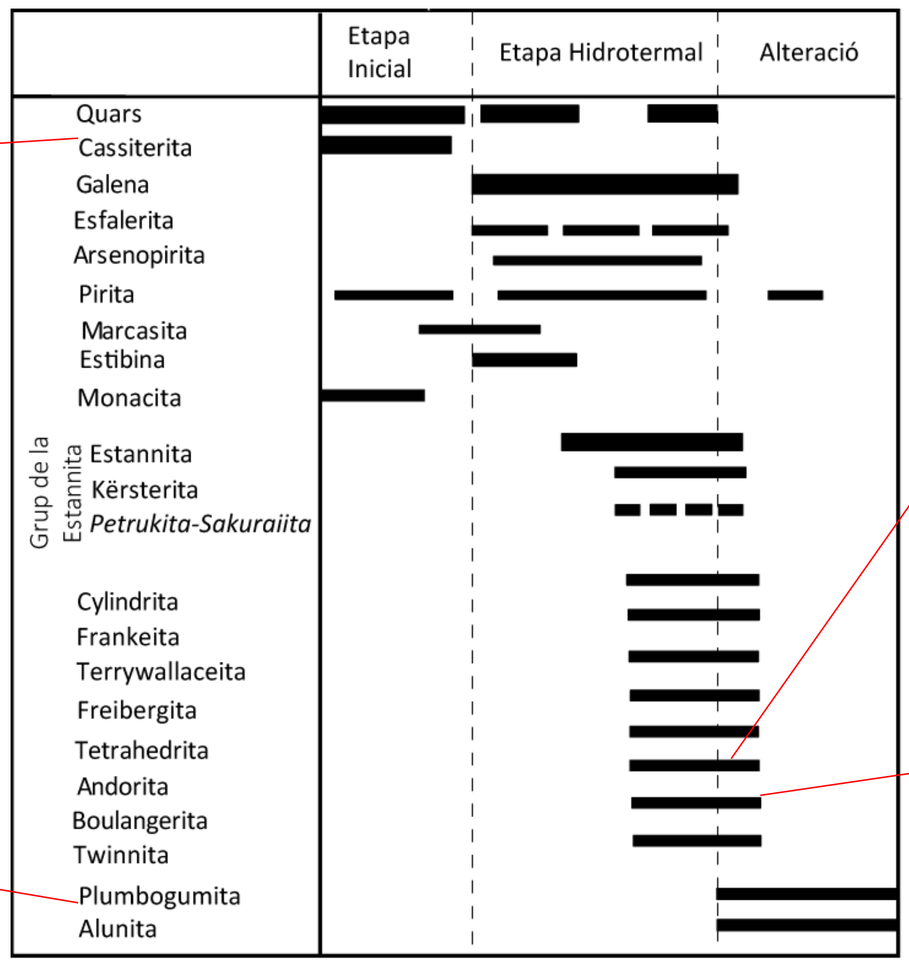
SEM images of sakuraiite and roquesite; white numbers represent wt% of in.

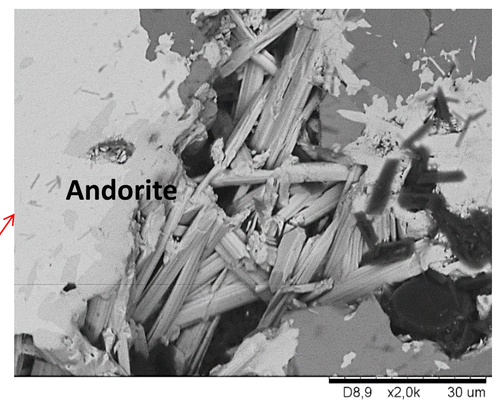
Paragenetic sequence

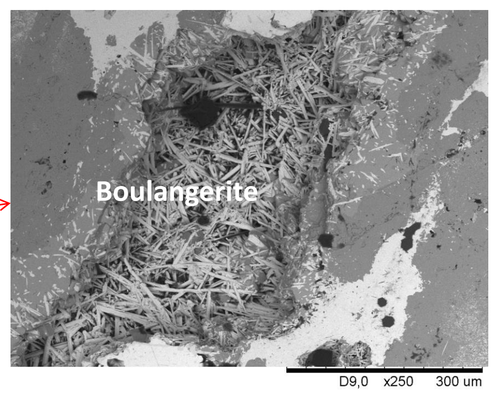
Three stages are distinguished: early, hydrothermal and supergene alteration.











Conclusions

In this stud several mineral phases that have not been reported in the San Jose deposit until now were identified. Some of these minerals, especially stannite group, show significant In contents.

Acknowledgements

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